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ABSTRACT

This report provides an overview of selected key national and multinational initiatives in digital preservation occurring outside North America. It examines digital preservation initiatives in four countries--Australia, France, the Netherlands, and the United Kingdom--as well as related multinational initiatives. The initiatives were chosen in consultation with the U.S. Library of Congress (LC) and the Council on Library and Information Resources (CLIR) because they were believed to be of particular relevance and interest to the U.S. National Digital Information Infrastructure and Preservation Program (NDIIPP).This study aims to put these initiatives into their national and international context and to outline major developments. It presents the key findings from the survey and details of the main initiatives in each country. (Contains 14 references.) (Author)

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Commissioned for and sponsored by the National Digital Information Infrastructure and Preservation Program, Library of Congress

by Neil Beagrie

April 2003

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Council on Library and Information Resources
Washington, D.C.
and Library of Congress

About the National Digital Information Infrastructure and Preservation Program

The mission of the National Digital Information Infrastructure and Preservation Program is to develop a national strategy to collect, archive, and preserve the burgeoning amounts of digital content, especially materials that are created only in digital formats, for current and future generations.

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About the Author

Neil Beagrie became program director for digital preservation in the Joint Information Systems Committee (JISC) in June 2000. He is responsible for the activities of JISC Digital Preservation Focus. This program is developing JISC policy, guidance to institutions, and collaborative programs for digital preservation, electronic records, and digital collection management on behalf of the Higher and Further Education Councils and institutions in the United Kingdom.

He was research director and coauthor of *Preservation Management of Digital Materials*, a study published by the British Library in 2001. He founded and coordinated the development of a cross-sectoral Digital Preservation Coalition in the United Kingdom and became its first company secretary. In addition to moderating the digital preservation listserv, he is a member of the Preserving Access to Digital Information (PADI) International Advisory Group and the RLG/OCLC Working Group on Digital Archive Attributes.

From 1997 to 2000, he was assistant director of the Arts and Humanities Data Service (AHDS). In that post, he developed digital collections policy and standards and published extensively on digital preservation issues. He was joint author with Daniel Greenstein of the study *A Strategic Policy Framework for Creating and Preserving Digital Collections* (1998). Before joining the AHDS, he was head of Archaeological Archives and Library at the Royal Commission on the Historical Monuments of England.

He has previously worked as a consultant with the U.K. New Opportunities Fund Digitisation program and the U.K. Department of Environment.

Mr. Beagrie completed this report in a private capacity as a consultant.

Foreword

Libraries and archives have long recognized the importance of international cooperation and collaboration. As cultural and scholarly institutions in particular and society in general have embraced information technologies, digital content and the networks over which it is transmitted have shown how permeable civil and national boundaries can be. This phenomenon has highlighted the importance of cooperation in the global world of information as well as the subtleties of navigating within the physical world of different institutional, legal, and economic cultures. Our challenge is to respect those many boundaries and differences while sustaining practices and programs that will enable us to preserve contemporary digital expression for use by generations to come. Few would deny the long-term importance of digital information, whether it is embodied in text, Web sites, electronic books and periodicals, music, images, cinema, or any other format. How to preserve that digital content, however, presents an open and demanding set of questions.

The importance of answering these questions has become greater as the volume of digital information has increased. For the last two-and-a-half years, the Library of Congress (LC) has been engaged in an extensive planning process as part of the National Digital Information Infrastructure and Preservation Program (NDIIPP). Created by the U.S. Congress in December 2000 under Public Law 106-554, the NDIIPP calls on the LC to lead a national planning effort for the long-term preservation of digital content and to work collaboratively with representatives of other federal, research, library, and business organizations. The LC has interpreted its charge broadly to include consultations with colleagues at other national libraries who have begun to address the challenges of digital resources and from whom we have much to learn.

Neil Beagrie's report on selected international initiatives is an important step in our commitment to listen, learn, and share our findings. The report offers a framework within which we can understand and compare programs that sometimes seem disparate and confusing. The study contextualizes its findings in a set of reasonable forecasts about the near future of information technology and the landscape in which that technology is likely to be situated.

In consultation with LC and the Council on Library and Information Resources, Mr. Beagrie identified national programs in Australia, France, the Netherlands, and the United Kingdom that were likely to be similar to the then-nascent NDIIPP effort. Drawing on information collected in a series of interviews and site visits early in 2002, he systematically describes each program's (1) national context, including mission and relevant legal framework; (2) institutional and national initiatives and projects; (3) international initiatives; and (4) planned or future international initiatives. He amplifies these findings with other examples that are not strictly national in scope but are highly influential, such as the Open Archival Information System and Preservation Technology for European Broadcast Archives.

All these efforts, as well as LC's parallel investigations, demonstrate that digital preservation requires more than technology, important though technology is to any set of solutions. One of the fundamental challenges for NDIIPP is to identify an organizational framework as well as technological tools and systems that are flexible enough to empower local and regional decisions and mobilize efforts while sustaining overall coherence. The massive scale of digital information and the complexities surrounding it mandate cooperation among many institutions and at many levels.

Over the last century, libraries and archives have developed many ways to work together. Our history of cooperation for the sake of future scholarship is a powerful tool as we seek ways to preserve digital content for the generations to come. This report reminds us of that tradition and helps us see how to use our experience as we move forward into the age of digital information.

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Acronyms

ADRI	Australian Digital Resource Identifier
AHDS	Arts and Humanities Data Service
ARNO	Academic Research in the Netherlands Online
AWIICS	Archival Workshop on Ingest, Identification, and Certification Standards
BBC	British Broadcasting Company
BL	British Library
BnF	Bibliothèque nationale de France
CASL	Council of Australian State Libraries
CCSDS	Consultative Committee on Space Data Systems
CDNL	Conference of Directors of National Libraries
CENL	Conference of European National Librarians
CLIR	Council on Library and Information Resources
CNC	Centre National de la Cinématographie
CNES	Centre National d'Études Spatiales
COUPERIN	Consortium Universitaire des Périodiques Numériques
DADs	Digital Archive Directions
DLS	Digital Library Store
DNEP	Deposit of Netherlands Electronic Publications
DNEP-i	Deposit of Netherlands Electronic Publications-implementation
DOI	Digital Object Identifier
DOMS	Digital Object Management System
DOSS	Digital Object Storage System
DPC	Digital Preservation Coalition
ERPANET	Electronic Resource Preservation and Access NETwork
EU	European Union
HATII	Humanities Advanced Technologies and Information Institute
INA	Institut National de l'Audiovisuel
INRIA	Institut National de Recherche en Informatique et Automatique
IPR	Intellectual property rights
ISO	International Standards Organization
IT	Information technology

JCVD	Joint Committee on Voluntary Deposit
JISC	Joint Information Systems Committee of the Higher and Further Education Councils
KB	Koninklijke Bibliotheek
LC	Library of Congress
LOCKSS	Lots of Copies Keep Stuff Safe
LTP	Long-term preservation
NARA	National Archives and Records Administration
NDIIPP	National Digital Information Infrastructure and Preservation Program
NEDLIB	Networked European Deposit Library
NIWI	Netherlands Institute for Scientific Information Services
NLA	National Library of Australia
NPO	National Preservation Office
OAIS	Open Archival Information System
OCLC	Online Computer Library Center
PADI	Preserving Access to Digital Information
PANDORA	Preserving and Accessing Networked Documentary Resources of Australia
PIN	Pérennisation des Informations Numériques
PRESTO	Preservation Technology for European Archives
PRO	Public Record Office
RAI	Radiotelevisione Italiana
SCOLD	Standing Committee of Legal Deposit Libraries
SIMONE	Simple Onix Editor
SIPAD	Système d'Information, de Préservation et d'Accès aux Données
TEL	The European Library
UNESCO	United Nations Educational, Scientific and Cultural Organization
UVC	Universal Virtual Computer
W3C	World Wide Web Consortium

1.0 EXECUTIVE SUMMARY

1.1 Aims, Scope, and Methodology

This report provides an overview of selected key national and multinational initiatives in digital preservation occurring outside North America. It examines digital preservation initiatives in four countries—Australia, France, the Netherlands, and the United Kingdom—as well as related multinational initiatives. The initiatives were chosen in consultation with the U.S. Library of Congress (LC) and the Council on Library and Information Resources (CLIR) because they were believed to be of particular relevance and interest to the U.S. National Digital Information Infrastructure and Preservation Program (NDIIPP).

This study aims to put these initiatives into their national and international context and to outline major developments. It is intended to be a high-level survey; for this reason, it does not aim to be exhaustive or detailed in terms of practice and procedures. This report presents the key findings from the survey and details of the main initiatives in each country.

1.2 Key Observations and Recommendations

This section of the Executive Summary begins with the author's observations on principal trends and lessons. This is followed by individual observations and recommendations from each national library on the lessons learned as a result of its work for the NDIIPP. Their views on opportunities for future international collaboration in digital preservation are presented separately in each national overview in the main body of the report.

1.2.1 Author's Observations and Recommendations

The national libraries surveyed differ greatly in scale and scope of collections and in responsibility. Although all the libraries have responsibility for the print and literary heritage of their respective

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countries, their responsibilities for audiovisual materials vary substantially. Each country also has a slightly different focus in terms of digital publications and is at a different stage of developing digital collections and digital preservation.

These differences in scope and scale of collections and individual national circumstances need to be borne in mind when considering the implications and lessons of this survey for the LC or the NDIIPP.

This report and the national surveys it contains are a snapshot of the status of activity as of March 2002. As time passes, further changes and new initiatives will need to be taken into account.

Despite these caveats, the author believes that there are significant lessons and opportunities for both the LC and the NDIIPP highlighted within this report.

National Initiatives and Funding

In none of the countries surveyed is there a single national initiative for digital preservation. Rather, there are many institutional missions that are being extended into the digital domain, including those of national institutions such as the national archives and national libraries.

There are some new efforts to provide national or international coordination and collaboration between such initiatives. One national example is the Digital Preservation Coalition (DPC) in the United Kingdom. Two examples of international efforts for information exchange are the Electronic Resource Preservation and Access Network (ERPANET) and Preserving Access to Digital Information (PADI).

Digital preservation is poorly funded in relation to the scale of the challenge. Institutions have received little or no additional core funding to address digital preservation; as a result, they must rely on short-term external project funding or reallocate internal resources. There are limits to what can be achieved by such means, particularly in large institutions or national programs.

In providing a funded and coordinated national program for digital preservation, the NDIIPP is seen internationally as a leading initiative.

It is far easier to obtain funding for digitization for access than for preservation. The long-term benefits and requirements of preservation seem often to be overshadowed by the immediate benefits of current access initiatives. Many countries are placing increasing emphasis on short-term project funding and are reluctant to increase the core funding of institutions. Increases in core funding will be necessary to make the longer-term commitments needed for preserving large digital collections.

Digital preservation relies on the collaboration of stakeholders outside memory institutions and the professional sectors they represent. Much digital preservation activity as a public good is supported either from government funds or private benefactors. However, awareness of digital preservation issues among the public, government, and other key stakeholders remains low. Significant effort should be placed in targeted outreach to key individuals and audiences as part of the development of the NDIIPP to ensure it has

effective support and engagement with key communities. The public relations campaign launched by the DPC in the United Kingdom is seen by its member organizations to have been highly successful, and it may provide useful parallels for part of any outreach program in the United States.

Underlying Trends

The digital domain is changing the nature of institutions' missions and their relationships with other organizations. These changes can be summarized as follows:

- Changing patterns of distribution. Increasingly, institutions do not hold physical copies of digital works but license access to them. It is unclear who will have responsibility for archiving, and the level of trust in archiving arrangements is uncertain.
- Changing time horizon for preservation. Digital media are fragile, and access to them is dependent on rapidly evolving hardware and software that quickly become obsolescent. Preservation of digital materials, therefore, does not happen by accident; it requires early action, often at the point of creation. In the digital environment, memory institutions must have much closer relationships with creators and distributors than was previously necessary. In addition, preservation actions must be taken earlier. Selection decisions can be harder, because they may have to be made earlier in the life of the material and without the benefit of time, which reveals the historical importance of different trends and material.
- Changes in intellectual property rights (IPR) and archiving rights. No country in the survey has comprehensive legal provisions for archiving digital publications. The term of copyright has been increasing, and the investment in and economic value of IPR have also increased dramatically. The commercial need to protect IPR can overshadow other considerations. The needs of memory institutions for legal exceptions to undertake archiving are often overlooked or not sufficiently understood.
- Globalization. Activities increasingly take place on a global scale and outside the traditional national frameworks for digital preservation. With the development of international publishers who can deliver their digital publications from anywhere, the role of archiving in a national context is less clear. Similarly, the growth of the Web and the international activity it empowers transcend national boundaries.

  Globalization also applies to developments in hardware and software. Information technology (IT) companies and market trends operate on a global scale and apply to many different sectors. This means that there is more substantial common ground between institutions internationally and across sectors and greater potential for and benefits from international collaboration.
- The information explosion. The volume and range of information produced is expanding dramatically. Now, digital publications in many countries supplement, but have not replaced, traditional

publication. This increase in both traditional and digital information is straining national institutions, particularly national libraries, which have a tradition of comprehensive collection in specified areas. At the same time, many of the traditional filtering and editing roles of publishers are disappearing as the Web opens publishing to individuals and organizations. This places greater demands on the libraries in selecting material for acquisition.

This exponential increase in information is not confined to publishing; it applies even more to data in the academic and research sectors, particularly in the sciences.

- Publications and records. In the digital environment, it is no longer necessary to generate many copies in order to publish material. A single copy can be networked and made accessible to anyone with a PC and an Internet connection. The boundaries between a "publication," a "manuscript," and an "archival record" have blurred. The respective roles of libraries and archives may have a greater degree of overlap in the digital environment.
- The cultural record. Publications are now only one aspect of popular culture and the cultural record. Film, television, and the World Wide Web define an increasing part of our culture. Mechanisms to consider new areas of collection development and future research needs may be required as part of any national scheme.
- The role of the private collector. Private individuals have frequently been vital in preserving collections of material, particularly ephemera that have not been in areas of contemporary collection by curators. In the digital environment, examples of private initiatives include Brewster Kahle's Internet Archive or the sharing of early computer games and emulators by private enthusiasts. Digital preservation challenges and copyright protection mechanisms may make such efforts harder in the future. This could result in greater reliance on institutional selection decisions and the development of new tools to support personal archiving.

Digital Preservation

Institutions such as archives and libraries have evolved over many centuries as custodians of the "collective memory." They are custodians over very long periods of time. Other institutions and sectors may be focused on shorter time horizons and rarely have this chronological perspective. It is not surprising, therefore, that memory institutions have been first to identify the challenges associated with digital preservation.

However, the challenges identified by archives and libraries will in time affect a wide range of institutions and may have a profound effect on the individuals and society in which they operate. Digital preservation is therefore not solely a cultural heritage issue. In the longer term, it will affect the nature of the "information society" that many governments worldwide are seeking to develop. There is a surprising lack of discussion or research into these deeper trends and the implications behind digital preservation issues.

Digital preservation is still a new field. Most initiatives have fo-

cused on selection, acquisition, storage, and maintenance of digital collections. Actions needed for long-term preservation (LTP) are only now being identified and addressed. The most successful initiatives noted in the survey were located at institutions that had been working on practical implementations and policy for several years.

Collaboration and Partnership

Collaboration between institutions occurs on many levels. External funding has encouraged collaboration on research. In some cases, collaboration with other institutions has been a requirement of such research funding. Research collaboration has also occurred without this external incentive, but it is often on a less formal basis or with fewer resources.

It has been harder to collaborate and coordinate on collection policies. The PANDORA (Preserving and Accessing Networked Documentary Resources of Australia) archive, which has evolved over many years, is the only real example of this in the survey. Coordinating and distributing responsibility among institutions is also seen as important in the United Kingdom, but this country still has some way to go to put appropriate arrangements into effect.

Partnerships seem to work best when the participating institutions have their own initiatives and experience and when all parties have something to offer to and to gain from the collaboration. It is important to develop in-house expertise as well as to use experience available externally.

All the libraries in the survey emphasized the importance of working with stakeholders. This report notes many examples of successful approaches, including agreements between publishers or publishers' trade bodies and national libraries. Outreach publications aimed at data creators have also been produced by the Arts and Humanities Data Service (AHDS) in the United Kingdom (the "Guides to Good Practice" series) and the National Library of Australia's (NLA's) information leaflets on safeguarding Australia's Web resources.

Digital libraries are a relatively small sector, and they benefit not only from working together but also from being aware of trends and potential partnerships in other sectors. An example of this is the Open Archival Information System (OAIS) reference model, which is emerging as the first international standard in digital preservation. While developed by the communities engaged in earth observation, OAIS has broad applicability and has been widely adopted in the library community. The library community, in turn, has heavily influenced the development of the draft reference model.

Digital preservation and related issues such as mass storage and automation of metadata are likely to be important elements of the "research grids" being developed to support collaborative science and the scientific research infrastructure. The NDIIPP should explore and encourage opportunities for synergies with these developments.

Governments worldwide are encouraging developments in "e-government" and "information society" that are having a major

impact on the provision of digital access and on the development of digital work processes and procedures. Electronic records management often figures in such programs, but longer-term issues are seldom considered. The Digital Longevity Program in the Netherlands is a rare exception to this rule. Similar awareness raising and close engagement with e-government initiatives is recommended as part of the NDIIPP.

Many of the traditional certainties of publication and archiving are in flux as we move into the digital environment. Few institutions are likely to be directly involved in digital preservation, but many are likely to be involved in providing access services that may rely on such archiving activities for long-term access. Funding and institutional models for this set of relationships remain to be defined; however, there are a number of interesting developments. One such development is that some international publishers have recognized certain archives as official archives for all their published output (see the Koninklijke Bibliotheek [KB] and Elsevier in the Netherlands). Another development is the potential growth of collaborative archiving arrangements for consortia linked to national deposit libraries or academic research libraries (see COUPERIN [Consortium Universitaire des Périodiques Numériques en France] or JISC in the United Kingdom).

National libraries offered several recurring suggestions for international cooperation in developing effective strategies for long-term preservation:

- There is a need to develop a preservation technology watch for file formats and new technologies, emulators and migration routines, and information on and repositories for obsolete software. National libraries felt there is significant scope for international collaboration and potential cost benefits in developing these services on a shared basis.
- In larger national programs, there may be scope to develop some shared services and central support for digital preservation in a distributed network of digital archives.
- In the academic sector, the OAIS and exploration of new methods of scholarly communication are growing rapidly. The focus of these initiatives is improving current access, and there is less consideration of long-term requirements for preservation. The position of such repositories, the materials they hold, and any long-term requirements should be considered in any national collaborative scheme.
- There is also a need to foster research on LTP and to develop standards and good practices. This would be an obvious area for engaging in international effort and for developing closer partnerships with national research funding bodies and academic research institutes and departments.

Staff Training and Development

Most institutions in the survey raised staff training and development issues. Digital preservation may require new positions for individu-

als with a crossover set of skills and a broad view of operations to coordinate and direct activities. However, most of the effort will be drawn from existing staff and will require teamwork across departments and skill sets within the institutions.

Audiovisual Materials

The audiovisual preservation community is in many ways unique within the survey. Because the media and technologies used in their industries have been impermanent and cannot be preserved long-term, digitization is widely accepted as their preferred method of audiovisual preservation. The film, audio, and video archiving communities, therefore, have a direct stake in resolving digital preservation challenges over the next decade.

Although not a primary focus of this study, audiovisual materials have been included to some degree. Three observations stand out:

- The audiovisual community has undertaken extensive research and evaluation of the archival qualities of storage media such as recordable compact disks (CD-R). This work is not widely known in the library community but is highly relevant to a broader audience and deserves to be better known.
- Audiovisual storage requirements are very large. Moving from offline storage, such as CDs, to mass-storage systems will require very large-scale storage systems.
- The PRESTO project is one of the few examples of an attempt both to identify the scale of preservation requirements for a group of institutions and to construct an effective business case for further investment. The Library of Congress should examine the survey questionnaire, the survey outcomes, and the technologies being developed.

Research and Development

National libraries have identified Web archiving, whether by selective gathering of specific Web sites or whole domain capture for specific national territories, as an important function. It is recommended that work within the United Kingdom, France, Australia, and Scandinavia be followed closely and that opportunities for the joint development of tools and practice be explored.

The OAIS reference model has become widely accepted as a standard in digital preservation. It is recommended that OAIS be used within the NDIIPP, and that support be given to further key developments. These may include the production of accessible guides to major concepts behind the standard, dissemination and sharing of experience among implementers of the standard, and efforts to develop supporting guidelines and standards in areas such as identifiers, "ingest," and certification.

The survey highlights the need for persistent identifiers. This is an issue not only for online publications and the Web but also for the linking and citation of primary research and data sets. Further work on persistent identifiers as part of the NDIIPP is recommended, as is close liaison with international developments in this area.

Several ingest activities—the acquisition and processing of digital objects into collections—need further development. The space science community is focusing on space mission data. Within the library community, there is a need to focus on metadata from publishers. Promising preservation metadata schema have emerged, and the RLG/OCLC Working Group on Preservation Metadata is developing an international framework.

The logical next step is to examine implementation issues. Many publishers are international and would respond positively to international standards and coordination of requirements. Links to metadata standards being developed within the publishing community, such as ONIX, would also be desirable. The needs of publishers of all sizes will need to be considered. In this respect, current work to develop Simple Onix Editor, a tool for automating production of ONIX metadata funded by the British Library at Book Industry Communication, may be of interest.

With the development of new roles and potentially new interdependencies among different organizations, it will become increasingly important to certify digital archives. Further consideration and support should be given to defining benchmarks or institutional standards for digital preservation and certification models.

There has been relatively little major research in digital preservation. This area warrants investment for further research and development.

It is recommended that NDIIPP consider carefully the outcomes of the research projects noted in the survey. Consideration should be given to building on these projects and to developing one or more digital preservation testbeds to evaluate the scalability, strengths and limitations, and costs of promising approaches.

Dissemination

Institutions vary greatly in the extent to which they distribute their work on digital preservation—for example, the information they mount on their Web sites.

There is a need to ensure that information, tools, and experience are shared effectively within the international community. This survey describes several international and national efforts having this objective. It is recommended that the NDIIPP consider carefully how information on U.S. initiatives should be disseminated, how such dissemination should be supported, and how the initiatives relate to and participate with similar activities internationally. This survey provides a number of exemplars and suggestions, including the need to ensure that such efforts are specifically funded. There is also potential to coordinate such work with that being undertaken by the DPC in the United Kingdom, ERPANET in Europe, and the NLA.

There are pronounced differences in the extent to which various institutions are exposed to, are aware of, and respond to international developments. International exposure seems highly beneficial and is apparent in many of the most successful initiatives included in the survey. Such exposure should be encouraged within the NDIIPP.

1.2.2 National Library of Australia Observations and Recommendations to NDIIPP

1. Know your critical stakeholders and work with them. For example, the NLA found it essential to build goodwill with publishers, particularly in the online environment.
2. Recognize that collaboration takes effort and leadership, and has its own limitations. Do not underestimate the investment in relationship building and the diplomatic skills needed. Give-and-take is needed, and results accumulate over time.
3. Make a start, and then let experience, practice, and policy evolve and inform each other. Recognize you cannot solve all the problems at once. Starting small on defined areas and building in feedback mechanisms for continuous learning are essential.
4. Integrate digital preservation into the institution. Do not rely on time-limited external or project funding to achieve your aims.
5. Build on the people and expertise you have. The NLA has developed its internal staff and established teams working across departments to bring together relevant skills. Look for internal synergies to support the activity.
6. Realize that it is initially hard to calculate costs. Cost models depend on many variables, and the NLA is in an experimental phase of development. Cost recognition and management can, however, be improved over time.
7. Recognize that the major challenges are not only conceptual but also practical. Addressing them requires developing policy and experimenting with strategies and procedures.
8. Consider the merits of the selective approach to archiving online resources. It is one of many approaches, but for research use, the intervention of the librarian is important and cannot be replaced.

1.2.3 Bibliothèque nationale de France Observations and Recommendations to NDIIPP

1. Be aware that addressing the deposit and preservation of online materials is a key issue.
2. Recognize the value of sharing research and jointly developing approaches to Web archiving between institutions.
3. Conduct research on collecting and preserving database-driven Web sites.
4. Be aware that trying to influence what publishers produce is a critical issue. Libraries have difficulty with CDs and other materials in proprietary standards today, and it will be even more difficult for these resources to be accessed tomorrow.
5. Establish early contacts with producers of electronic materials. The BnF is considering undertaking more initiatives with publishers.
6. Recognize that raising awareness about digital preservation within one's own institution is as important an issue as influencing others externally.

1.2.4 Koninklijke Bibliotheek Observations and Recommendations to NDIIPP

1. Recognize the difference between the publishers' value-added service environment and the underlying content. Take the publications out of the service environment and into the archiving environment of the library.
2. Use standards such as the OAIS where they exist.
3. Work with other organizations to encourage the development of commercial market solutions and systems for digital preservation.
4. Begin by identifying what you have in common with potential partners rather than how you differ. Use this common base to focus and scope what you want to do together.
5. Recognize that successful digital preservation initiatives depend on getting staff involved across the institution. Many management issues need to be addressed.
6. Be aware that collaboration requires time and a sense of community. Participants must make face-to-face contact and must know their partners.
7. Keep membership of project teams stable. Continuity is essential to maintaining progress and the relationships built up with partners.
8. Emphasize how important it is that institutions communicate with each other and share lessons learned. All institutions agree with this in principle, but a staffing commitment is needed to make it happen. This is rarely done in practice because of conflicting time commitments. Specific funding may be needed to allow institutions developing and practicing digital preservation to communicate their work.
9. Appoint project leaders who can make things work and who have a positive attitude toward problem solving.

1.2.5 British Library Observations and Recommendations to NDIIPP

1. Have leadership from the front on the issue of digital preservation and strong commitment from senior management.
2. Communicate the urgency of the problem. Preservation is a digital time bomb; failure to act may lead to total loss.
3. Recognize that the requirements for access in a large project such as the Digital Library Store (DLS) are very complex. There is a need for a modular approach focusing on the store as well as for access and integration via other systems. Progress with the DLS has not been easy, and the scoping of the project has been difficult.
4. Be aware of the need for an overarching e-strategy, particularly in very large libraries with complex systems. It is important to keep all digital developments in step and to consider the interface between systems.
5. Learn from parallel work in other institutions. Collaboration with the KB has been particularly useful for the BL. At the same time, differences in scale are important when looking at national libraries and transferable lessons.
6. Recognize that working more in partnerships will be essential if

digital preservation is to be addressed successfully. However, collaboration can complicate things and has costs as well as benefits.

7. Do not underestimate the importance of sufficient staff. The pool of specialists and generalists in digital preservation is very small. In searching for a digital preservation coordinator, the BL recruited from Australia. Digital preservation cuts across a wide range of activities and departments. Awareness and capacity must be built internally so that a wide range of staff can contribute to digital preservation as part of their daily activities.
8. Get behind one initiative, such as the DPC, rather than become involved in competing groups.
9. Focus collaborative activity in an organization separate from any single partner but with heavy involvement from each of the key players.
10. Do not seek the "ultimate preservation solution," which remains elusive, said the National Sound Archive. Not all challenges will be solved instantly, and a combination of approaches is likely to be appropriate. We must use professional skills and harness technology now to maintain holdings in our generation and to ensure we can plan to migrate them for future generations.

1.2.6 Recommendations for Further Technical Investigation

The author recommends that the Price Waterhouse Coopers Consultancy for NDIIPP undertake further detailed investigation in the following areas:

Australia

- The PANDORA distributed national online collection and the software used to support this collaborative archiving effort
- The NLA Digital Objects Management system and proposals for developing its capacity to manage long-term preservation
- The NLA digital preservation work program
- Proposals for the national Australian Digital Resource Identifier scheme

France

- The Web harvesting tools and approaches being developed by BnF
- The preservation technologies being developed by Institut National de l'Audiovisuel (INA) as part of the PRESTO project

Netherlands

- The Deposit of Netherlands Electronic Publications (DNEP) digital deposit system for electronic publications being developed by the KB and IBM-Netherlands
- The outcomes of the Long-Term Preservation Study being conducted by the KB and IBM-Netherlands and its implications for the development of a LTP module as part of the DNEP
- The Digital Preservation Testbed being conducted by the Dutch Ministry of the Interior and outcomes of these experiments

United Kingdom

- The British Library's DLS
- The e-preservation strategy and systems being developed by the Public Record Office
- The outcomes of the Cedars research project
- The outcomes of the CAMiLEON research project
- The audiovisual and new media preservation technologies and projects being developed by the BBC

Other Projects and Initiatives

- The audiovisual preservation technologies being developed by Radiotelevisione Italiana as part of the PRESTO project
- The research outcomes and tools from the Networked European Deposit Library (NEDLIB) project
- The OAIS reference model and implementations noted in the report

2.0 AIMS, SCOPE, AND METHODOLOGY

This report provides an overview of selected national and multinational initiatives in digital preservation occurring outside North America. The report examines current digital preservation initiatives in Australia, France, the Netherlands, and the United Kingdom, as well as related international initiatives. These countries and initiatives were chosen in consultation with LC and CLIR as being of particular relevance and interest to NDIIPP.

The report puts these initiatives into their national and international contexts and outlines the major developments. It is intended to provide a high-level survey. It does not aim to be exhaustive or detailed in terms of practice and procedures. This report presents the key findings from the survey and details of the main initiatives in each country. The LC will use the report to provide an international perspective on current initiatives that can inform the development of national policies and programs in the United States.

The survey was written for senior administrators and policy makers—that is, people who are not specialists in digital preservation or access to networked information. It is a high-level synthesis rather than a detailed document—a report that teases out significant issues and major lines of development and their implications. Although the report focuses on national digital preservation initiatives in libraries, it also refers to relevant significant developments in other sectors. The preservation of audiovisual resources has been included as an aspect of the national reporting, for example, the National Sound Archive as part of BL. Preservation of audiovisual material is not, however, a main focus of the report.

The survey is based on information gathered from desktop research and from data supplied by the national libraries between January and March 2002. In consultation with CLIR and LC, the author developed a questionnaire addressing specific aspects of the national

libraries' initiatives. The questionnaire also allowed the respondents to provide information about their respective national contexts and to identify related initiatives.

In addition to interviewing staff members in the national libraries, the author visited the BBC, which is the lead partner in the PRESTO project, and the Digital Longevity Digital Preservation Testbed in the Netherlands to learn more about these initiatives. After the interviews, the author sent interviewees the completed draft questionnaire and draft report section for their respective countries to obtain comments, additions, or corrections.

The following individuals were interviewed:

Bibliothèque nationale de France
Catherine Lupovici, Julien Masanès

British Broadcasting Corporation
Richard Wright

British Library
Helen Shenton, Crispin Jewitt

Digital Preservation Testbed, the Netherlands
Jacqueline Slats, Maureen Potter, Tamara van Zwol, Remco Verdegem, Bill Roberts, Ingmar Evers, David Bowen

Koninklijke Bibliotheek
Hans Jansen, Titia van der Werf, Johan Steenbakkers

National Library of Australia
Colin Webb, Margaret Phillips, Pam Gatenby

The research has been coordinated where appropriate with members of the Price Waterhouse Coopers consultancy, which LC commissioned to evaluate preservation technologies and system architectures.

3.0 NATIONAL SURVEYS

3.1 Australia

3.1.1 National Context

The Commonwealth of Australia has a system of federal and state governments. This is mirrored in its library system. There is a National Library in Canberra and libraries in the states and territories supported by local government. Australia has, in other words, a distributed system of national and regional library collections.

There is no explicit national legal deposit for electronic publications in Australia, although it is anticipated that this will be intro-

duced in due course. There is some provision for deposit in legislation in some states.

The NLA has a responsibility for preserving the national print-based and oral documentary heritage under the National Library Act, but ScreenSound Australia is responsible for film, sound, and broadcast. ScreenSound and NLA are working jointly on proposals to extend legal deposit legislation to electronic materials and audio-visual materials in physical formats.

Australia has a strong digital online culture. Internationally, Australia has one of the highest levels of Internet connections among its population (surpassed only by the United States and Singapore). In part, this reflects the distances between population centers across the continent and the need for organizations to reach many of their audiences online. For a country with a relatively small population, Australia has a relatively large number of leading-edge online projects across all sectors. Archiving these online materials has become a significant area of effort for Australia's memory institutions, and both the NLA and the national archive activities and guidelines are frequently cited internationally as exemplars in this area.

There are few large international publishers in Australia. Most commercial Australian publishing is focused on print publications. Online publishing has tended to be from new entrants to the market and noncommercial sources. There are 85 commercial publications within the national online collection, PANDORA, but this is a small part of the collection as a whole.

The National Office for the Information Economy in the Federal Government set a target for all federal services to be online by 2001. There has been a major push to enable rapid access to information and services from government departments.

There is an active electronic records management/archive sector in Australia. Work at Monash University, the PRO of Victoria, and the National Archive of Australia has earned an international reputation.

Australia has a national bibliographic database, KINETICA, and Australian libraries collaborate in its development for resource sharing. There has been a tradition of collaboration in developing the national catalog, and this has provided a foundation for collaboration in other fields.

3.1.2 The National Library of Australia

The NLA has a staff of 492 full-time equivalents and is a statutory authority within the portfolio of the Department of Communications, Information Technology, and the Arts. Its 2001 budget was $AU 206.7 million, of which $AU 45 million supported operational expenses.

The NLA's remit covers Australia's published and documentary heritage, and its sound holdings include oral and folk history.

Development of Digital Systems in NLA

In 1999, the NLA prepared a tender specification for a Digital Collection Management System and issued a request for information to

potential suppliers. It was unable to identify a supplier that met all its requirements and has proceeded with a combination of in-house development and external procurement in the following three areas:

1. Digital Object Storage System. This was procured externally and built from a number of subcomponents. It was installed and accepted in June 2001.
2. Digital Objects Management System. This is being built in-house to manage both archived electronic publications and digitized objects in the NLA collections. It is a phased development, and future releases will incorporate digital sound and long-term preservation management.
3. Digital Archive System. This software is being developed in-house to support PANDORA, the national distributed archiving system for online publications. There is Web access to all functions to facilitate involvement and use by partner organizations. Version 1 has been implemented and is highly regarded by NLA partners such as the State Library of Victoria. It has substantially reduced staff time needed to archive online titles. Version 2, scheduled for release in June 2002, will also support distributed storage for any partner that requires it.

Funding

All digital preservation activities at NLA have been supported by a reallocation of internal resources rather than by new funding. As a result, there has perhaps been greater emphasis on mainstreaming these activities within the library than there might have been if this work had been externally financed. Reallocating resources has been difficult, but there is now a core commitment to preservation activities in NLA.

Given limited funding, NLA has invested heavily in staff time and infrastructure to support collaborative archiving and is seeking to develop distributed responsibility for these activities.

NLA Digital Preservation Policy and Action Plan

The NLA has developed a Digital Preservation Policy, available on its Web site, which states the directions the library intends to take in preserving its own electronic information resources and in collaborating with others to maximize the effectiveness of digital preservation activities. At the time this report was prepared, the NLA was six months into a two-year action plan to implement the policy. The NLA is interested in developing a wider national action plan with partners.

The following digital preservation technologies are being evaluated:

- File format migration. The NLA is testing the migration of the PANDORA collection to html v4.01.
- Emulation. The NLA is developing a testbed for obsolete DOS systems.
- Web domain harvesting. A feasibility study on harvesting the Australian Web domain, initiated in 2001, is on hold.

- Data recovery. Work on recovery and transfer from floppy disk and CDs is documented in NLA staff papers.
- Viewers for obsolete formats. The library has purchased TRIM software from Tower systems for its records-management needs. It is evaluating the functionality of this software for viewing obsolete word processing formats.
- CD-R and mass-storage systems. The NLA has extensively evaluated CD-R as an archival medium. This work is documented in staff papers.
- Software repositories and technology watch. NLA is evaluating concepts for a software repository and a technology watch for file formats.

3.1.3 National and Institutional Initiatives

National bodies in different sectors are leading several national or institutional initiatives in Australia. National initiatives do not exist in all sectors (even institutional initiatives may be absent).

NLA initiatives are coordinated either through model agreements with trade bodies or through formal or informal bilateral arrangements with individual organizations. Formal arrangements may be made on the basis of institutional mission, geography (e.g., national or state), or by subject matter (archival records, publications, film, and broadcast or audio). The load may be distributed unevenly, depending on the resources and missions of partners in such arrangements

The NLA has led national collaborative initiatives for published materials, for example, the PANDORA archive. The partnership that is building PANDORA is based on a formal exchange of letters under which each institution takes responsibility to varying degrees for selecting, archiving, cataloging, preserving, and providing access to Australian online publications, according to agreed-upon criteria and processes. PANDORA has operated since 1996, and the partnership has gradually extended to other organizations, including ScreenSound Australia, the state libraries, and one territory library. The State Library of Tasmania has developed its own procedures and policy for its institutional initiative, Our Digital Island, which is archiving online publications and works closely with the NLA toward joint goals. It is strongly considering using the PANDORA Digital Archiving System with the option of storing files on its own server. The diversity of their approaches has enabled the NLA and the State Library of Tasmania to share lessons learned and to coordinate initiatives, such as developing a scheme for a national persistent identifier. Some areas of the national online collection remain to be covered; among these are the evolving preprint archives.

Incentives for participation in national initiatives vary from sector to sector. For publishers, deposit with the NLA means being included in the national bibliography, greater exposure for their publications, and ongoing access to their publications without the cost of maintaining them. The NLA agrees to restrict access to commercial material so that commercial interests are not threatened by deposit.

For other libraries or institutions, collaboration may secure the following:

- access to shared infrastructure or policy that would be expensive to procure individually, for example, PANDORA selection guidelines;
- Stronger advocacy, for example, NLA and ScreenSound Australia's joint representation on legal deposit; and
- Access to and sharing of expertise and project learning internationally, for example, involvement in RLG/OCLC working groups.

For all entities participating in national initiatives led by the NLA, a degree of empathy is implicit for securing the cultural heritage of Australia and therefore for supporting the mission of the NLA in achieving this.

National initiatives include the following projects:

PANDORA (Preserving and Accessing Networked Documentary Resources of Australia)

The NLA and its partners collaboratively maintain PANDORA, the national collection of Australian online publications. PANDORA is internationally recognized as a key initiative in the selective archiving of online materials. The collaboration has extended to include all State libraries and one Territory library, as well as Screensound Australia. Material for inclusion in PANDORA is selected either by the NLA or its partners. There is central storage of material at NLA. The NLA has developed archiving software for distributed selection, gathering, and deposit. Version 2 of this software will allow distributed storage and will accommodate the specific local development within Tasmania.

The NLA, in consultation with the Council of Australian State Librarians (CASL), has developed a template for shared selection guidelines for the National Collection of Australian Online Publications. This provides a consistent basis for developing a distributed national collection of online materials while allowing for institutional collection approaches to be incorporated.

Code of Practice for Providing Long-term Access to Australian Online Publications

The NLA has developed this draft in consultation with the Australian Publishers Association to cover archiving and preservation of, and access to, commercial publications produced in Australia. Given the small size of the Australian commercial publishing industry, the code will not have extensive application outside of Australia for some time. However, it has been invaluable in developing awareness among the commercial publishers and in preparing the ground for discussion of legal deposit of electronic materials.

Australian Digital Resource Identifier

The NLA is developing a national persistent identification scheme for electronic information resources in collaboration with the State Library of Tasmania and on behalf of CASL. The scheme, to be known as the Australian Digital Resource Identifier (ADRI), will provide a guide for organizations to name their resources in a way that will ensure continued access to the resources in the future. CASL endorsed in principle a draft schema for ADRI in November 2001.

Other Australian projects and initiatives include the following:

Our Digital Island (Tasmanian State Library)

The TSL has developed this selective Web archiving initiative for online publications in the State of Tasmania.

Higher Education Sector

There has been relatively little digital preservation work in the Australian higher education sector, although a major conference, "Digital Continuity," was convened in November 2001 to consider the state of the art and how Australian universities should engage with the issues. There is a national digital theses program with distributed archiving by institutions and a central interface for access. Two university libraries are establishing e-print archives.

Sound Archives

Australia has an active sound archiving community that for years has been using digital formats for archiving.

The NLA and ScreenSound Australia have instituted many evaluation and life testing trials on CD-R and digital audio tapes. The expanding capabilities of mass-storage systems now make them viable for the storage and preservation of large amounts of audio data. The NLA is migrating its audio holdings from CD-R to mass storage.

The radio network of the Australian Broadcasting Corporation has implemented a computer-based digital on-air system. Consequently, they do not generate analog copies of new material and now archive on CD-R.

Picture Australia and Music Australia

There are several significant and innovative national resource discovery initiatives to access outcomes from digitization projects involving the NLA and other partners. These include Picture Australia and Music Australia.

3.1.4 International Initiatives

The NLA believes that international collaboration at many levels is essential in digital preservation; to this end, it wants to work with the U.S. Library of Congress and other international agencies.

Current collaborative international activities include the following:

Preserving Access to Digital Information

Preserving Access to Digital Information (PADI) is a digital preservation gateway maintained by NLA and individual and institutional partners in Australia and abroad. It started as a voluntary initiative among a number of Australian organizations; later, a single institution was created to give the program the resources it needed to develop fully. The NLA has led in development of PADI and provides staff and systems support. In 2001, PADI's functionality was extended to allow registered individuals outside the NLA to enter information directly into the PADI database.

PADI has an international advisory group, and the NLA has sought to develop collaboration in maintaining PADI internationally. Individuals have been able to register as contributors and input directly since 2001. More recently, the NLA and the Digital Preservation Coalition (DPC; see section 3.4.3) have agreed to a memorandum of understanding on collaborative activity. This will include DPC input to PADI and a series of links and joint activity. This arrangement could be mirrored in future with other organizations worldwide.

Safekeeping Initiative

The Safekeeping Initiative was established with seed funding from CLIR. It aims to identify key digital preservation resources recorded in PADI and to secure agreements for their long-term preservation. The NLA is evaluating this initiative.

Conference of Directors of National Libraries

The director-general of NLA is chair of the Conference of Directors of National Libraries (CDNL). CDNL has set up a digital issues group, which has an action plan that concentrates on legal deposit, persistent identification and digital archiving, and preservation research needs. This group was instrumental in submitting a digital preservation resolution to United Nations Educational, Scientific and Cultural Organization (UNESCO). The KB chairs the digital issues group.

International Research Projects

The NLA staff contributes to the OCLC/RLG Working Group on Preservation Metadata and the RLG/OCLC Working Group on Digital Archive Attributes. Through review comments, the NLA has contributed significantly to the OAIS reference model, NEDLIB, and other international projects in digital preservation, including the development of *Preservation Management of Digital Materials: A Handbook* (Jones and Beagrie 2001).

3.1.5 Future International Collaboration

The following were seen as potentially important areas for future international collaboration by NLA:

- working on persistent identifiers
- exploring how national collections can be linked
- developing a global or distributed software archive

- documenting and sharing information on preservation dependencies in publications
- implementing a technology watch for file and media formats
- sharing and discussing research and evaluations of specific implementations
- implementing preservation metadata with international publishers
- developing archive certification models arising out of the RLG/OCLC Working Group on Digital Archive Attributes
- Establishing fail-safe mechanisms globally for collections (it was recognized this is more difficult and sensitive than some of the previous suggestions and might be a lower or long-term priority)

While it is often easy to agree on international collaboration, real progress is difficult unless resources are dedicated to the work. There needs to be rigorous discussion of what is useful for both parties and what resources must be committed.

3.2 France

3.2.1 National Context

Passed in 1992 and implemented in 1993, France's national legal deposit legislation covers publications of all types produced or distributed in that country. The legislation does not specifically mention electronic publications, but the act has been applied to offline electronic publications such as CD-ROMs that have been produced in France. Under the legislation, responsibilities are divided among the following institutions:

- The Bibliothèque nationale de France is responsible for all published documents, videos, and multimedia works.
- The Centre National de la Cinématographie is responsible for film.
- The Institut National de l'Audiovisuel is responsible for radio and television broadcasts.

There is regional deposit for printed material in 19 regional libraries. However, there is no regional deposit for electronic publications. Two copies of electronic publications that exist in physical formats, such as CD-ROM, must be deposited with BnF.

It is estimated that there are more than 300,000 Web sites in France, excluding hosted sites. In July 2000, a recommendation was made to extend the legal deposit legislation to cover electronic materials on the Web. A legal process is now under way to achieve this. When the law is enacted, producers based in France will be obligated to deposit their Web sites. Producers can meet this obligation by depositing materials directly by ftp or on a physical carrier, or by arranging for the library to harvest the site. The law will not specify whether Web archiving is to be selective or exhaustive, and selection decisions will be at the discretion of the library. Much discussion is expected with producers over implementation of any new law. Any new legislation is unlikely to be declared before 2003–2004.

All librarians in French research libraries, which include the university libraries and the national library, are civil servants employed by the Ministry of Education. For this reason, there is a regular movement of staff between the national library and the provinces. There is a single national school for training librarians.

There is substantial government investment in scientific research, and the Institut National de Recherche en Informatique et Automatique (INRIA) is one of the three centers for the Worldwide Web Consortium (W3C).

The French archives law sets out rules for managing public archives and for protecting private archives. The law applies to all local and national public organizations. Although French archives are under central direction through the Archives of France (a directorate of the French Ministry of Culture), they are highly decentralized; the National Archives, for example, consists of five separate centers.

There is growing interest in long-term preservation of digital information across many sectors in France. This is reflected in a number of international conferences arranged there on the topic in the last year.

3.2.2 The French National Library (Bibliothèque nationale de France)

The Bibliothèque nationale de France (BnF) is funded through the French Ministry of Culture and has a staff of 2,800. It has an annual budget of 1 billion French francs for operating costs. This sum excludes salaries, which are controlled by and paid for separately by the Ministry of Education (the librarians) or the Ministry of Culture (other staff). Six hundred staff members are on short-term contracts funded from the operating costs. The library does not lend materials or supply documents. It is solely a library of last resort with on-site access to any material in copyright that has been deposited.

Digitization of collections started in 1992 and includes materials in the national library and in associated library collections. There has been a strong focus on digitizing public-domain print collections, and they are made available through the Gallica Web site. The digitized collection consists of homogenous documented formats and has already been migrated once. A large program for digitizing video has just started.

Digital Systems

The library has 100 Unix servers, 150 NT servers, and 3,000 workstations. There is a 150-MB ATM network internally and a 150-MB connection externally through the research network in Paris. There is distributed computing power and 24/7 service capability across the library; however, a central archival store is considered a necessary future development. The current main approach to long-term preservation is to develop a preservation metadata database to inform migration and preservation decisions across these distributed storage systems.

Funding

Digital preservation initiatives are funded through the operational budget. Funds are reallocated to support experimentation with Web archiving. However, additional funding is being sought to continue this work in 2003.

Digital Preservation Policy and Actions

There is a separate workflow for electronic legal deposit publications within BnF. The audiovisual department takes all electronic deposit materials because it already has equipment for accessing recorded CDs and digital tapes. Of the two deposit copies, one is retained within the audiovisual department and the other is sent to a BnF conservation building outside Paris.

The library has just formed a working group to develop digital preservation across all its departments. It includes representatives from the Digital Library Project team and the library's audiovisual, IT, conservation, and collections departments. The working group will gather information on the scale of work needed across the library, what is being done, and what is being considered. It will adopt the OAIS model and apply it within BnF. Julien Masanès is the group's coordinator and serves as project leader for evaluating Web site archiving.

In December 2000, BnF launched a set of experiments on archiving the national Web domain. No access is given to materials in this experimental Web archive. Future public access on-site at the BnF will depend on arrangements in any revised legal deposit legislation. The goal of these experiments is to evaluate costs and to define procedures for selection, transfer, and preservation that can be applied for any new legal deposit law extension to online materials.

The library is working with INRIA to test their XYLEME software as a tool for Web archiving. The project leader is working with collections staff to see whether the automated weighting this software provides can be used to help in the selection of Web sites for archiving.

3.2.3 National and Institutional Initiatives

The division of responsibility for legal deposit is set out in legislation. The load is divided according to the type of material, as noted above. A scientific committee oversees implementation of the legislation.

The Ministry of Culture has funded coordinated research on technology, including research on producing archival-quality CDs.

The Centre National d'Etudes Spatiales (CNES) has led the development of the OAIS reference model standard in France and has coordinated development of an informal group, Pérennisation des Informations Numériques (PIN), that is working on this and other standards and guidelines.

Pérennisation des Informations Numériques

The NEDLIB project, described in section 4.2, made extensive use of the draft OAIS reference model standard. This led to initial contact

from BnF with staff at the CNES who had been part of the international earth observation and space data community that worked on developing the standard. Organizations interested in discussing the OAIS model met in June 2000, and PIN was then established as an informal forum and discussion list administered by CNES. The purpose of the forum is to contribute to work on developing the OAIS standard and on standards and practices for its implementation, and to share information between organizations. Participation is voluntary and PIN relies on the contribution of effort by the individuals and organizations that attend. Members take turns hosting meetings. Participants include

- Archives de France
- Archive-17
- Bibliothèque nationale de France
- Centre des Archives Contemporaines, one of the five centers within the National Archives
- CNES
- Commissariat à l'Energie Atomique
- Groupe Mederic
- INA
- Institut Pasteur

Public Records

The Archives of France is developing guidelines for electronic archives. The Archives of France control the National Archives and the regional, departmental, and municipal archive agencies, as well as the archive agencies of organizations that are authorized, by way of derogation, to manage their permanent archives.

The Archives of France is exploring the possibility of cooperating with BnF on archiving government Web sites. Such collaboration would have significant technical benefits, because French archives are decentralized and central IT support is limited. It is anticipated that the Archives will want to process Web sites differently than the BnF does, given archival interests in the hierarchy and administrative context of the documents.

The Institut National de l'Audiovisuel

The INA is responsible for France's cultural audiovisual heritage. Under legal deposit legislation, INA is responsible for deposits from the country's six national television channels (public and commercial) and five public radio channels. Under the French communications law, INA is also responsible for maintaining the archive for public radio and television.

INA is one of the three major partners in the PRESTO project, described in section 4.4. It is making heavy use of digitization for preservation and also taking more material in born-digital form.

INA wants to extend its mission to the French Web and is developing a harvester with the École Nationale Supérieure.

Academic Sector

The university libraries are starting a scheme for submitting university theses in electronic formats. The scheme provides style sheets in Word and reformats submissions into XML. The project is based at Lyon University and is just beginning to consider long-term preservation. The institutions will archive the theses and will not deposit them with the BnF.

The Consortium Universitaire des Périodiques Numériques (COUPERIN), the main purchasing consortium for university libraries, is concerned about the archiving of and future access to the journals to which it subscribes. COUPERIN is reluctant to rely solely on publishers for these long-term arrangements. It has begun discussing with the BnF arrangements under which BnF would archive electronic journals that fall outside of legal deposit. BnF would wish to seek payment for this; however, because the costs of digital preservation are uncertain, BnF cannot now make contractual commitments to third parties.

3.2.4 International Initiatives

Networked European Deposit Library

The BnF was a partner in the NEDLIB project, described in section 4.2, and led work on defining preservation metadata. Catherine Lupovici and Julien Masanès coauthored the NEDLIB metadata report (2000).

Open Archival Information System

CNES has had a major involvement in the OAIS standard, described in section 4.3. It is currently leading work within the Archiving Group on Ingest Methodologies.

PRESTO

INA is one of the three lead partners in the PRESTO project, described in section 4.4.

3.2.5 Future International Initiatives

The BnF is keen to take part in international activities, but time pressures make it hard to participate on any scale or to follow everything that is happening or that has been disseminated through e-mail lists or digital preservation gateways. They highlighted the following as areas of priority for future international collaboration:

- The library would like to see joint research in technical areas such as harvesting the Web or reformatting databases behind database-driven Web sites into XML. They believe this area would also be of interest to the Library of Congress.
- The NEDLIB project was highly regarded by the BnF, and the library would like to see some practical extension of this activity among national libraries.

3.3 The Netherlands

3.3.1 National Context

There is no legal deposit legislation in the Netherlands for either print or electronic publications. Consequently, the KB has worked in this area on its own initiative and as a natural extension of its mission to safeguard the nation's published heritage.

The KB has developed voluntary agreements on deposit of electronic publications with publishers. It first formed bilateral agreements with Elsevier and Kluwer, which dominate Dutch publishing and provide most of the electronic journal titles accessioned by the KB. In June 1999, the library signed a general agreement with the Dutch Publishers Association.

Voluntary agreements have limitations in that publishers do not always have rights in third-party materials. Only statutory provisions could resolve these difficulties. For this reason, The KB still wishes to see a statutory right to archive publications, perhaps through the national implementation of exceptions in the European Union (EU) Copyright Directive.

The Dutch government aims to carry out 25 percent of its transactions with citizens digitally by 2002. There is thus significant investment in a program to develop strategies, methods, techniques, and tools to support e-government and information society initiatives. Concerns about business continuity and electronic records led to the establishment of a Digital Longevity Program as part of these initiatives. There are five projects within this program, including a digital preservation research testbed and a task force to support awareness raising and communication across government agencies.

Activity in the academic sector has focused on establishing e-print and digital archives concerned with access and new models for electronic publishing.

A national plan for preservation, the Delta Plan, has operated since 1991 and has assessed the preservation needs of print and manuscript materials. In 1997, a national program for the preservation of library materials, Metamorfoze, was launched. This is coordinated by the National Preservation Office (NPO) of the Netherlands, which also provide grants to support preservation. The NPO is organized by and housed in the KB. The program focuses on reformatting paper to microfilm, deacidification, and some assessment of digitization as a preservation surrogate.

All publications deposited with the KB are cataloged into the national bibliography. The cataloging is done using a joint system operated by the KB and all the research libraries in the Netherlands. Pica and OCLC technically maintain the joint cataloging system. From the resulting bibliographic database, a national union catalog is produced.

3.3.2 The National Library of the Netherlands (Koninklijke Bibliotheek)

The KB has a staff of 350 (about 260 full-time equivalents) and is funded through the science section of the Ministry of Education, Culture and Science. Its budget in 2002 was 80.4 million guilders (36.5 million euros).

The KB collects the published and literary heritage of the Netherlands. Its collections comprise mainly book and serial publications. This can include multimedia publications, but at present it does not collect any audiovisual, film, or broadcast materials or software, games, or databases. (The KB may collect databases in the future.) The KB is also interested in the future selective archiving of parts of the Dutch Internet domain.

KB initiatives include developing the Digital Archive Store Project (DNEP), a national agreement on voluntary deposit with publishers, a long-term digital preservation study with IBM, and many digitization projects, including the Memory of the Netherlands and Treasures of the National Library. The latter two projects focus on improving access and interoperability with other collections.

Development of Digital Systems

There has been investment in developing access systems and particularly in Web access to the catalogs.

The new deposit system for electronic publications has developed in a number of distinct phases. The KB was the lead partner in the EU-funded NEDLIB project and helped develop its guidelines for electronic deposit systems. These guidelines propose creation of a controlled environment for storing and maintaining electronic publications (the deposit system) and developing transfer procedures for electronic publications to the deposit system. NEDLIB also employed Jeff Rothenberg of the RAND Corporation to investigate the feasibility of emulation as a long-term solution for digital preservation.

In 1999, the KB investigated the feasibility of obtaining an operational deposit system for its electronic publications from commercial information technology suppliers. The KB concluded that the storage and management functions could be obtained from existing vendors. However, for long-term preservation and access, it was clear that no off-the-shelf solutions were available and that KB would need to commission specific research to develop the required functionality.

In September 2000, the KB contracted with IBM-Netherlands to build the new deposit system. The Deposit of Netherlands Electronic Publications-implementation (DNEP-i) contract also includes applied research from IBM to develop new functionality for long-term preservation and access (work referred to as the "LTP study"). A major requirement of the KB was that the system should be compliant with the OAIS standard. The KB required the design of the system to be linked with the LTP study. IBM is developing the data model so that in the near future an operational LTP module can be fitted into to the system.

At the end of 2001, the first module for delivery and capture was made available. The system will be completed in October 2002.

The DNEP-i project aims to yield an OAIS-compliant operational deposit system and to test and demonstrate requirements for the future development of a long-term preservation module, which will need to be added to the deposit system.

This long-term preservation module will be needed to

- identify digital objects in danger of becoming inaccessible because of technology changes;
- implement preservation strategies to address these dangers, such as migration and emulation; and
- supply the technical metadata needed to generate and validate the required viewing environments for digital objects during delivery.

Preservation Actions

The LTP study will involve six months of work over a one-year period and will cost 300,000 guilders (136,134 euros). Its objective is to investigate the functionality required for the long-term (that is, hundreds of years) preservation of the digital information stored in the DNEP. The study began in November 2000, with the start of the DNEP-i project. It aims to cover the following issues:

- *Implementation of Long-term Preservation.* The initial DNEP system has a limited functionality for maintaining the technical data (hardware and software components) needed to render the stored digital objects. One of the main responsibilities of the LTP study is to define the functional requirements of the preservation subsystem not considered in the initial DNEP release. In the end, the preservation subsystem should maintain all the technical metadata needed to render the digital objects.
- *Universal Virtual Computer Proof of Concept.* The preservation approach advocated by Raymond Lorie at the IBM Almaden Research Center, based on the use of a Universal Virtual Computer, is being refined and validated in the context of the KB.
- *Large Media Migration.* Electronic deposit applications face specific problems while migrating information from one medium to another because of the high volume of data involved. The impact of these volume-specific requirements on the DNEP system has to be assessed.
- *Authenticity.* A workable framework to define authenticity of digital objects is needed to evaluate the success of the preservation activities of any electronic deposit.

The KBM and IBM are jointly producing five LTP study reports (one report on the four issues just described and a general synthesis).

In addition to the work just described, the KB has engaged in the following initiatives:

- The KB is participating as a test site in the final year extension of the Cedars Project (see section 3.3.4).
- The KB undertook an experiment with the NEDLIB Web harvester to investigate the Dutch Web domain. It found that only 20 percent of sites were of interest to the KB and that a significant number of these were database driven.

- The KB has undertaken research on workflows for electronic journals that are being implemented in the new system. It is also developing a new workflow for CD-ROMs that will be integrated into the new deposit system.

Funding

The KB has a national role in the public interest and therefore supports its activities with government funding. The KB believes its public service role is paramount and does not wish to adopt a commercial model. Fees for services are set only to recover costs.

Between 1998 and 2001, the KB received 3.2 million guilders (1.45 million euros) plus some research funding to prepare for the development of the new deposit system. Beginning in 2003, annual funding of 2.5 million guilders (1.14 million euros) will be available to support this activity.

The KB currently holds the Dutch imprint of the Elsevier group under a voluntary deposit arrangement, and it has been archiving a subset of Elsevier's electronic journals for some years. It has agreed to archive a copy of all Elsevier's electronic titles. This extension of the KB's activities might need additional funding, depending on the range and nature of the services to be delivered. Economic models to support this work are under investigation. The KB would not wish to charge users other than for cost recovery of specific services. The KB is interested in funding models where such services are free to the user but paid for by the producer, who recovers the cost in product pricing. Examples of the application of this funding model in other areas include the models developed to support use of the digital object identifier (DOI) in publishing, or barcodes in retailing.

Most collaborative initiatives are not funded and must rely on matching contributions in staff time and other resources from the partners.

3.3.3 National and Institutional Initiatives

Digital Longevity (Digitale Duurzaamheid)

There are five projects within the government's Digital Longevity Program, including a digital preservation research testbed (described in the next section) and a task force to support awareness raising and communication across government agencies. Other projects concern central government databases, record-keeping systems, and quality of records. The program is run by ICTU, an agency established to oversee the e-government program.

The KB is a member of the task force for the Digital Longevity Program. As part of the program, the National Archives has been discussing renting part of the storage space on the KB platform to provide interim storage for electronic records transferred from government departments.

Digital Preservation Testbed (Testbed Digitale Bewaring)

The Ministry of the Interior and the Ministry of Education, Culture and Science (the National Archives) established a three-year digital

preservation testbed as part of the Digital Longevity Program. The project began in October 2000 and will conclude in September 2003. The testbed was preceded by a research study by Rothenberg and Bikson (1999). The digital preservation testbed is carrying out experiments according to defined research questions. It is researching three approaches to long-term digital preservation: migration, emulation, and XML. It is experimenting with text documents, spreadsheets, e-mail messages, and databases of different size, format, complexity, and nature. The effectiveness of each approach for different material is being evaluated, as are their limitations, costs, and application potential.

The following outcomes are expected:

- advice on approaches for current digital records in government departments
- recommendations for the best preservation approaches for specific circumstances
- functional system requirements for preservation
- cost models for different preservation approaches
- preservation approach decision trees
- recommendations for new legislation

The project has so far produced a research base. A list of relevant projects and a white paper on migration are available online.

The project is collaborating with the Public Record Office (PRO) in the U.K. and the National Archives and Records Administration (NARA) in the United States, and has informal links to ERPANET and Interpares through staff at the Dutch National Archives.

Public Records

Dutch archives are funded through the Ministry of Education, Culture and Science. Historically, there have been a federal government archive and 12 state archives with some local archives for specific municipalities or polders. The national structure is being reorganized to create a federal government archive with a national archive service of regional archive centers. The 1995 archives legislation covers electronic public records and requires that they be transferred to the archive after 20 years. Regulations introduced in 2000 specify the formats and metadata in and with which the records must be presented.

Netherlands Institute for Scientific Information Services

The Netherlands Institute for Scientific Information Services (NIWI) is an institute of the Royal Netherlands Academy of Arts and Sciences. It curates and provides access to primary research data and research information in biomedicine, social sciences, history, and Dutch language and literature. In addition, it supplies information about research and researchers in the Netherlands in all scientific fields. Its current projects include one pilot effort in digital preservation. Titled Archiving Digital Academic Heritage, the project is exploring the feasibility of setting up digital archiving services for scientific or scholarly research material in the Dutch academic sector.

In the pilot, the research data files of the Meertens Institute are being archived. Marketing research will be undertaken to establish the level of demand for archiving services in the academic sector.

Roquade

Three Dutch university libraries were partners in the Roquade project: Utrecht University Library, Delft University of Technology Library, and the NIWI. The project researched development of electronic archives to enhance scientific communication in the academic sector. The project estimated the cost of metadata assignment, administration and quality control, and technical infrastructure for an electronic archive accepting 5,000 items per year to be 29 euros per item.

Academic Research in the Netherlands Online

Academic Research in the Netherlands Online (ARNO) is developing university document servers to make available the scientific output of participating universities. Project participants are the University of Amsterdam, Tilburg University, and the University of Twente. The project is building on earlier Dutch electronic publishing projects and the Open Archives Initiative.

3.3.4 International Initiatives

NEDLIB

The KB chaired the NEDLIB project between 1998 and 2000. Funded by the EU, NEDLIB was a collaborative project of national libraries and other partners researching the infrastructure upon which a networked European deposit library could be built. (NEDLIB is described in greater detail in section 4.2.)

Conference of European National Librarians

The KB participates in the Conference of European National Librarians (CENL) and occupies the CENL chair. CENL is an independent association of the chief executives of the national libraries in member states of the Council of Europe.

COBRA+ Forum

The KB also participates in the COBRA+ Forum. COBRA+ is a standing committee of CENL. It was the key forum for developing proposals for European projects such as NEDLIB and The European Library (TEL).

KB/BL Memorandum of Understanding

The KB has had a memorandum of understanding since 1995 with the British Library covering collaboration on digitization. In December 2000, this agreement was updated to include collaboration on digital preservation. The BL has observer status on the KB/IBM LTP study, and there is joint review of documents as both groups develop their deposit systems.

Cedars Project

The KB is a test site in the final year of the Cedars Project (described in section 3.4.3). It is using the Cedars namespace to look at allocating and cross-referencing persistent identifiers in a demonstrator project. The KB had previously participated in Cedars Project discussions about defining the significant properties of publications.

Conference of Directors of National Libraries

The Conference of Directors of National Libraries (CDNL) has set up a group on digital issues that is chaired by the KB (the KB is simultaneously vice-chair of CDNL). The group has an action plan that concentrates on deposit agreements, persistent identifiers, and digital preservation research needs. It was instrumental in getting the UNESCO General Conference to adopt a digital preservation resolution. The Dutch national government submitted this UNESCO resolution and the KB helped formulate the text.

International Research Projects

KB staff members contribute to the OCLC/RLG Working Group on Preservation Metadata. The KB has provided significant input to the OAIS reference model. KB staff members also regularly present papers at relevant international conferences.

3.3.5 Future International Initiatives

The KB sees the following as potentially important areas for future international collaboration:

- For long-term preservation activities, it will be necessary to develop registries of file formats, migration tools and emulators, and technology libraries with obsolete software and its documentation. Although libraries could develop such registries individually, there are obvious cost benefits in collaboration. Such services could easily be networked and shared internationally.
- More research is needed on long-term preservation.
- National libraries are developing new workflows and skills to handle digital materials. Experience and emerging practices should be shared internationally.
- There should be more discussion and collaboration internationally on materials selection and on responsibility for long-term preservation. National libraries will always have a responsibility for their own cultural heritage; however, electronic publishing and businesses are increasingly global rather than national in scope, and national imprints are less easy to define. Alongside the national collections, we may see the development of archives for international publishers. How these international collections can be funded and fitted within national frameworks and institutions remains to be defined. If funding were available, some national libraries might take a wider international role.
- The KB has undertaken some pilot activity in Web archiving but recognizes that some other national libraries now have substantial experience in this field. It believes Web archiving is an area with

substantial scope for collaboration and sharing of experience and tools among the national libraries.

- The KB perceives that there is little real research on digital preservation in memory institutions. This is partly because of reliance on external funding. Funding bodies are focusing on relatively low-risk activity, such as workshops and reports. To counteract this, they suggest that institutions themselves pool some funding from their operational budgets and earmark it for digital preservation technologies research. Such research need not be expensive if the cost is shared.

3.4 United Kingdom

3.4.1 National Context

There is a network of copyright deposit libraries in the United Kingdom consisting of the British Library, the National Library of Wales, the National Library of Scotland, the Bodleian Library at Oxford, Cambridge University Library, and Trinity College Library Dublin. A Standing Committee of Legal Deposit Libraries provides a forum for joint discussion and activities.

There is no legal deposit legislation for electronic materials, although forthcoming legislation is anticipated. The British Library has a Joint Committee on Voluntary Deposit, which is a forum for discussion with publishers and the other U.K. copyright libraries on progress with voluntary deposit of electronic publications and future legislation. Some degree of distributed archiving is likely to be adopted, although most will probably be at the British Library.

The government is leading a move toward devolving powers to the regions, and few institutions have an absolute or U.K.-wide remit.

There are very large and long-established publishing and music industries in the United Kingdom, and this is reflected in the size of the BL's and other libraries' holdings and collections. Many commercial and noncommercial publishers based in the U.K. are producing digital works. They include international publishers of all sizes. The national mapping agency is now entirely based on digital surveys and deposits snapshots of its national topographical database (a geographic information system) with the BL.

The U.K. government has a significant drive toward electronic delivery of all local and central government services as set out in "Modernising Government," the U.K. government's agenda for modernizing public services. The target date is 2004. This effort will have a significant impact on Web delivery and electronic record keeping. This development is reinforced by progressive implementation across all public sectors of the Freedom of Information Act.

The United Kingdom has a diverse range of cultural institutions with digital preservation initiatives arising from their institutional missions, many of which extend beyond the institution concerned. These initiatives have had a high profile internationally.

The Joint Information Systems Committee of the Higher and

Further Education Councils (JISC) provides significant centralized digital research and development funding and coordination for the higher education and further education sectors in the United Kingdom. The digital focus of JISC and its central funding and direction mean that the U.K. higher education sector has played a major part nationally and internationally in digital preservation initiatives.

Across all sectors, memory institutions face significant funding constraints and have static or declining core budgets in real terms. They are required to balance the demands of traditional and electronic materials, and demands in both areas continue to grow.

Across the United Kingdom (perhaps with the exception of the data centers provided for primary research data), digital preservation efforts have focused on pilot projects, research, and guideline development. Although much has been achieved, there is a growing desire to move from projects to services. This is difficult to achieve when new funding is often of relatively short duration and project oriented.

The limited funding available to institutions individually and the scale of challenges involved have prompted partnerships and collaboration among institutions and serious discussion of whether responsibilities can be identified and shared. Discussions are at an early stage, and arrangements are likely to take some time to evolve

Although there is now a reasonable degree of awareness of digital preservation among curators and academic sectors in the United Kingdom, awareness among the general public and among key stakeholders, including senior civil servants, Members of Parliament, funding bodies, and publishers, is very low. This is a major impediment to increasing funding for digital preservation activities and in engaging with major stakeholders.

3.4.2 The British Library

With a staff of 2,400, the BL is a nondepartmental government body funded through the Department of Culture, Media, and Sport. Its budget in 2000–2001 was £110.26 million, of which £82.27 million was government grants in aid. The remaining £28 million came principally from document supply services.

The BL is the national library of the United Kingdom and has major international collections. Its sound holdings include published music, drama and literature, international music, wildlife sounds, and oral history.

There have been a number of significant digitization projects for enhancing access to the collections made possible by project funding from organizations such as The Andrew W. Mellon Foundation and New Opportunities Fund (a distributor of U.K. lottery funds). Within the next four years, it is anticipated there will be more than one million digitized images.

Development of Digital Systems

A procurement exercise for a long-term preservation facility, the Digital Library Store (DLS), was terminated shortly after submission

of this survey to the Library of Congress. The BL is exploring alternative options.

Digital storage for large-scale items such as digital master (TIFF) images is currently provided through a contract with the University of London Computer Centre.

Funding

All activities have been funded from existing government funding; there has been no increase for digital preservation activities. As other demands are also increasing, this has meant cutting back in some areas to fund new developments.

Collaboration in digital preservation activities has been on the basis of joint in-kind contributions of staff time and resources. For the Digital Preservation Coalition, described in section 3.4.3, the BL also contributes £10,000 per year as a full member.

There have been bids to government from the six copyright libraries to develop a secure network among deposit libraries. This would allow shared access to a single deposit for electronic materials and scope for distributing the archiving responsibility. So far, these bids have not been successful. The libraries are proceeding with a small demonstration project with project funding contributed jointly.

The BL has made a bid to the government for £600,000 annually starting in 2004 to begin selective Web site archiving combined with regular snapshots of the U.K. Web domain.

Digital Preservation Policy and Actions

The BL has issued "Strategic Directions," a future strategy for the BL that emphasizes development of electronic collections, digital preservation, and partnerships with other organizations. It suggests that collection policy will increasingly focus on the United Kingdom's published and literary heritage, and that there will be more focused acquisition of overseas publications. A public consultation on the proposed strategy is being undertaken and responses are being evaluated. There is a digital preservation policy used as a working document internally.

It is intended that legal deposit of electronic publications will cover all physical format and online publications in the United Kingdom, possibly with special arrangements for commercial databases. The Domain U.K. project has harvested 100 U.K. Web sites for a selected range of subject areas with permission from rights holders, and this experience is helping shape future selection guidelines.

Voluntary deposit of electronic publications was introduced in January 2000. It has been concentrated on physical formats published in the United Kingdom, but some publishers have also chosen to deposit online materials. Since January 2001, 3,000 electronic publication titles have been received under voluntary deposit from publishers. The voluntary deposit was initially focused on the British Library but may extend to other copyright libraries in due course. It is anticipated that only one copy would be deposited and access would be shared over a secure network.

Significant issues that have emerged from operation of the voluntary deposit scheme include the treatment of very high-value commercial databases and the metadata that can be supplied by publishers (particularly small and medium-size publishers) to accompany the deposit.

To address the metadata issue, the BL is partially funding development of a software package to help generate metadata to the ONIX standard being developed by publishers. The purposes of the Simple ONIX Editor (SIMONE) are

- to train ONIX users, especially those involved in ONIX record entry and record maintenance; and
- to enable small ONIX users to enter, maintain, and export records (for delivery as ONIX messages).

A "small ONIX user" is expected to be a publisher needing to create fewer than 100 records per year and to maintain fewer than 1,000 records, including front and back product lists.

By contributing to the development of the SIMONE software, which encourages the use of a common standard, the BL hopes to create future efficiencies and simplify the data input to its digital library systems.

In 2001, the BL appointed a digital preservation coordinator based in the Preservation Department to coordinate activities across the library and with external agencies and to provide a focus for advice and guidance to staff.

A range of pilot digital preservation projects, such as the voluntary deposit of electronic materials with publishers (to test procedures and policy before any legal deposit provisions), the Web site archiving pilot (Domain U.K.), and e-manuscripts and e-correspondence, are under way. The BL has also undertaken earlier pilot activities such as the CD-ROM demonstrator, which explored ingest procedures and costs for CD-ROM accessions.

The library contains the National Sound Archive, which has a longstanding voluntary deposit scheme with the music industry. The Sound Archive has undertaken research on the archival quality of CDs and will gradually move from offline CD storage toward mass storage as the DLS is completed.

Staff training has been a significant issue within the BL. The library has organized a number of "e-fairs" to demonstrate current projects to all staff and has sponsored lectures, seminars, and "learning circles" across departments.

The library has been used as a testbed for several research projects including Cedars, the *Preservation Management of Digital Materials Handbook*, and Lots of Copies Keep Stuff Safe (LOCKSS).

The library is a founding member of the DPC, and its chief executive is the coalition's current chair.

3.4.3 National and Institutional Initiatives

The Digital Preservation Coalition

Establishing a DPC was the primary recommendation of a U.K. digital preservation workshop convened at Warwick in 1999. The coali-

tion was established in July 2001 with the aim of pursuing a U.K. digital preservation agenda in an international context. The DPC is a membership organization and has a structure of full members, associate members, and allied organizations. In the eight months following the launch of the DPC, its membership grew to 19 organizations. It is cross-sectoral and includes all the significant institutions in the U.K. library and archive sectors as well as publisher organizations, research institutes, government agencies, and service providers.

Initial support for the DPC came from JISC through part-time involvement of a JISC-funded program director and funds from membership contributions. The coalition is a limited company. It has been a grassroots development with limited initial funding. Its first focus was advocacy, including a successful campaign to raise public awareness of digital preservation through the national press and a launch at the House of Commons. It held two members' forums in its first eight months of existence, the first on digital curation (particularly the OAIS standard and the U.K. e-science program) and the second on Web archiving. Information on the coalition is disseminated through its Web pages (www.dpconline.org) and the digital-preservation list on the JISC mail listserv (www.jiscmail.ac.uk/lists/digital-preservation.html).

The DPC has the following long-term goals:

- producing, providing, and disseminating information on current research and practice and building expertise among its members to accelerate their learning and to widen the pool of professionals skilled in digital preservation;
- instituting a concerted and coordinated effort to get digital preservation on the agenda of stakeholders in terms that they will understand and find persuasive;
- acting in concert to make arguments for appropriate and adequate funding to secure the nation's investment in digital resources and ensure an enduring global digital memory;
- providing a common forum for the development and coordination of digital preservation strategies in the United Kingdom and placing them within an international context;
- promoting and developing services, technology, and standards for digital preservation;
- forging strategic alliances with relevant agencies nationally and internationally and working together and with industry and research organizations to address shared challenges in digital preservation; and
- attracting funding to support achievement of DPC goals and programs.

The coalition adopted its focus on the assumption that the initiative would require much time in building relationships and membership and realistically should therefore be confined to the United Kingdom. At the same time, the founding members recognized the global nature of the challenges and the need to be linked to and foster international activity. The DPC has already focused on this inter-

national context by being involved with OAIS standard workshops and by developing a collaboration agreement with the NLA. It has a number of international members with U.K. interests.

Public Records

In the U.K., public records are those of central government rather than of local government, which are covered by separate legislation. The Public Records Act is seen as covering electronic records, although it is likely that further legislation will be required. The Public Record Office has an electronic records program and is providing guidance and toolkits for government departments. It is procuring a new storage system as part of its e-preservation strategy and developing new initiatives to support the strategy. Large-scale government data sets are being preserved through a seven-year service contract with the University of London Computer Centre. Responsibility for public records in Northern Ireland and Scotland lies with the PROs of Northern Ireland and National Archives of Scotland, respectively.

Joint Information Systems Committee Digital Preservation Focus

The JISC of the Higher and Further Education Councils is an institution unique to the United Kingdom. It is supported through public funding distributed through the councils to universities and colleges. It has been involved significantly in digital preservation initiatives. In June 2000, it established the JISC Digital Preservation Focus to provide further coordination to these initiatives, to develop strategy and guidelines, and to establish the DPC.

The initial three-year program of activities is drawing to a close, and the JISC Interim Preservation Strategy will soon be revised. The JISC is developing a new program that will include further digital research initiatives and new programs and services for digital preservation in the higher education and further education sector. A major area of concern is scholarly publishing and archiving arrangements for the large number of e-publications used in U.K. research and teaching that will fall outside any likely extension to U.K. legal deposit legislation. Other significant areas are likely to be institutional e-print archives and electronic records, project Web sites, structures to support digital preservation research, and e-science.

Primary Research Data

The United Kingdom has a Data Archive for the Social Sciences, established in the early 1970s, and a series of centers for data funded by the Natural Environmental Research Council. The national laboratories and the Sanger Centre also hold significant collections. Large-scale effort and funding are now being directed to developing e-science and a research grid in the United Kingdom. There are close links to similar developments in the United States, Europe, and elsewhere. There are significant digital curation issues within the grid, and digital preservation is seen as an important issue for scientific data that will be generated over the next decade. Linkages with digi-

tal library and preservation research are being explored and could lead to a significant investment in collaborative research.

The Arts and Humanities Data Service (AHDS) has been developed to provide data and preservation services in the arts and humanities. Established in 1996 by JISC as a three-year project to collect and preserve primary digital materials for research in the arts and humanities in the U.K., the AHDS has become a jointly funded service between JISC and the Arts and Humanities Research Board. The service was established on a distributed model with a central executive provider and five subject-based service providers.

The AHDS has produced a number of highly regarded guides to good practice and has a distinctive digital collections policy. This formed the basis for a research study entitled "A Strategic Framework for Creating and Preserving Digital Collections" (Beagrie and Greenstein 1998). The AHDS is undertaking a digital preservation audit of its holdings and will use the findings to inform and revise its preservation guidance.

Cedars Project

Funded by JISC and undertaken by the Consortium of University Research Libraries, Cedars is examining the preservation of electronic publications. Initially funded for three years, it was extended by one year to fully document and disseminate its findings and to involve new institutions in its work. Five reports are being produced from the final year of the project. A national invitational workshop involving publishers and libraries was held in February 2002. Further information and documents are available on the Cedars Web site.

The project has provided important conceptual advances in preservation metadata and influential ideas on significant properties, representation networks, and distributed archiving. It has also raised awareness of digital preservation issues among research libraries and publishers in the United Kingdom.

Cedars concluded in March 2002. JISC is undertaking a consultancy on archiving e-publications for the U.K. higher and further education sector. It is seeking to develop and move forward outcomes from Cedars through the future programs of JISC and the DPC and to promote the outcomes in other archiving programs such as those at national libraries.

The National Preservation Office

The National Preservation Office (NPO) for the United Kingdom and Ireland is based in the British Library. It coordinated the development of a series of seven JISC/NPO digital preservation research studies and has published other studies in this field. It is an allied organization of the DPC, and the two organizations have a memorandum of understanding on their respective roles and joint activities.

Preservation Management of Digital Materials: A Handbook

The AHDS and JISC Digital Preservation Focus jointly developed *Preservation of Digital Materials: A Handbook* (Jones and Beagrie 2001).

The research aimed to provide overviews of the key issues, decision trees, and checklists and to select significant research and exemplars worldwide. It was published by the British Library. A Web version has been made available and is maintained by the DPC. The handbook is linked to the PADI gateway through an agreement between the DPC and the NLA.

British Broadcasting Corporation Preservation Program

The BBC is one of the largest and oldest public broadcasters of television and radio programs in the world. It has a significant corporate archive. Responsibility for archiving this content rests with the BBC under its charter, but there is no separate funding stream for this. The BBC archive is a corporate archive and is used primarily to serve internal users. It is investing significantly in digital content both online and through digital delivery of programs. Although about 5 percent of television holdings are digital (less than 5 percent of radio holdings are digital), most new programming is now digital and digitization is seen as a key preservation method for analog holdings. There is a £60-million preservation program over 10 years for BBC television and radio archives. BBC Online is one of the most popular Web sites in Europe. A new media archivist has been appointed to develop records management and archiving of this and other digital content. The BBC is also one of the leading players in the PRESTO program.

3.4.4 International Initiatives

Most of the United Kingdom's digital preservation projects and initiatives involve international participation, often on a significant scale. The United Kingdom also has a major input into the development of international standards and working groups, including development of the ISO OAIS standard, Interpares, and the RLG/OCLC working groups on preservation metadata and on digital archive attributes.

Significant emphasis is placed, particularly within the U.K. higher education sector, on disseminating information and raising awareness about digital preservation through the Web and e-mail discussion lists, as well as through printed publications. There is therefore extensive international access to information on current digital preservation work in the United Kingdom or international work that the U.K. believes is significant.

The Humanities Advanced Technologies and Information Institute at the University of Glasgow is one of the four partners in the EU-funded ERPANET, which is described in section 4.1.

The DPC has a memorandum of understanding with the NLA and directly supports the PADI gateway through input of material from the United Kingdom.

There are also specifically international projects:

CAMiLEON

CAMiLEON is a three-year research project on digital preservation strategies jointly funded by JISC and U.S. National Science Foundation. It is based at the University of Leeds (technical research) and the University of Michigan (user evaluation). The project has looked at both emulation and migration as preservation strategies, using now-obsolete operating systems, programs, and data in its testing. Funding for the U.K. research will conclude in September 2002, and all U.K. deliverables are expected by December 2002. The technical approaches advocated for both migration-on-demand and emulation are of considerable interest and deserve wider discussion and testing.

KB and BL

A longstanding memorandum of understanding between the KB and the BL has recently been extended to cover digital preservation activities. There is collaboration on deposit systems implementation, and the BL is an observer on the KB long-term preservation research study.

European Sound Archives

A formal network of European national audiovisual archives is being established. There is a draft statement of intent on cooperation between them that is expected to be finalized and published after a meeting in Denmark late in 2002.

3.4.5 Future International Initiatives

The British Library sees the following initiatives as potentially important for future international collaboration:

- The BL is working closely with the KB and would welcome including the Library of Congress in future research on digital preservation. There is an opportunity to look at research on metadata and work with producers, particularly publishers, who are operating internationally.
- The European Library project is undertaking a feasibility study of shared access to digital collections in the European national libraries. This could also provide opportunities for collaboration on digital preservation.
- There is potential for the international development of services to support digital preservation in institutions. This could include software repositories and other tools.
- There is scope for greater international participation in and collaboration with the DPC, particularly as it develops services.
- A number of national libraries and other institutions internationally are now using the OAIS standard as a reference model for developing their digital archives. As initiatives evolve, there is an opportunity to share implementation experience and views on issues that arise. For example, the BL has recently had to consider whether records of items should never be deleted (as suggested in the OAIS standard) or whether deletion may be required in some exceptional cases.

- On digital preservation issues, the BL would like to see more research and involvement with computer science research departments both in the U.K. and internationally.
- The library believes that further international collaboration could occur on many levels, from pure "blue-sky" research to research and development with sister institutions on specific problems.

4.0 RELATED MULTINATIONAL INITIATIVES

4.1 Electronic Resource Preservation and Access NETwork

The Electronic Resource Preservation and Access NETwork (ERPANET) project was launched in November 2001 and will run initially for 36 months.

The European Commission funds 75 percent of this 1.2-million euro project. The following four partners manage the project:

- The Humanities Technology and Information Institute, University of Glasgow, United Kingdom
- Rijksarchiefdienst, the Netherlands
- Institute for Archival and Library Science, Università degli Studi di Urbino, Italy
- Schweizerisches Bundesarchiv, Switzerland

This new initiative is just establishing itself. The following information is taken from its Web site.

ERPANET aims to establish an expandable and self-sustaining European Initiative that will serve as a virtual clearinghouse and knowledge base in the area of preservation of cultural heritage and scientific digital objects.

The dominant activities of ERPANET will be the exchange of knowledge on state-of-the-art developments in digital preservation and the transfer of expertise among individuals and institutions. More specifically, ERPANET will deliver a range of services (for example, content creation, advisory service, training, and thematic workshops and forums), both to information-creation and user communities. It will make accessible tools, knowledge, and experience. ERPANET will not directly carry out new research to develop such tools, but it will create a coherent platform for collaboration, exchange, and dissemination of research results and experience in the preservation of digital objects. It will bring together research institutions, memory organizations, the information and communication technology industry, and entertainment and creative (for example, broadcasting) industries, and provide an effective multidisciplinary knowledge- and resource-sharing infrastructure.

ERPANET will enhance the preservation of cultural heritage and scientific objects through nine core objectives. It will

1. identify and raise awareness of information about the preservation of digital objects;

2. appraise and evaluate information sources and developments in digital preservation and make available results of research, including ongoing EU-supported projects;
3. provide an inquiry and advisory service on preservation issues, practice, and technology;
4. implement six development workshops to bring together experts to tackle key preservation issues;
5. hold a suite of eight training seminars based on best practice reflecting the needs of the community;
6. develop a suite of tools, guidelines, templates, and 60 case studies;
7. stimulate research and encourage the development of standards in the areas of digitization and digital preservation from within existing EU-supported projects and within Europe;
8. build an online community; and
9. stimulate awareness among software producers of the preservation needs of the user community.

4.2 Networked European Deposit Library

The NEDLIB project was launched on January 1, 1998, and ended on January 31, 2001. Funded by the European Commission, the project explored the technical and managerial issues involved in developing digital deposit libraries for electronic publications.

The project partners were eight national libraries, a national archive, two IT organizations, and three publishers. The KB led the project, and Johan Steenbakkers was its director.

Outcomes

The project resulted in the following:

- the addition to the OAIS standard of a function for long-term preservation planning
- a model for a deposit system supporting the capture, storage, access, and long-term preservation of electronic publications
- guidelines to best practices, technical standards and solutions, and methods and procedures for practical implementation
- small-scale development and testing of software tools used to build deposit systems
- a proof-of-concept demonstrator of a deposit system for electronic publications

The following seven reports were produced by the project:

- *An Experiment in Using Emulation to Preserve Digital Publications* (Rothenberg 2000)
- *Metadata for Long-Term Preservation* (Lupovici and Masanès 2000)
- *Standards for Electronic Publishing: An Overview* (Bide & Associates 2000)
- *Standards for a DSEP: Standards for the Implementation of a Deposit System for Electronic Publications (DSEP)* (Feenstra 2000)
- *The NEDLIB Guidelines: Setting Up a Deposit System for Electronic Publications* (Steenbakkers 2000)

- *A Process Model: The Deposit System for Electronic Publications* (van der Werf 2000)
- *List of NEDLIB Terms* (Clavel-Merrin 2000)

IBM-Netherlands has taken the NEDLIB work forward in implementing DNEP, the KB's new deposit system. The preservation metadata have also been adopted for use within the BnF and in its planning for a database of preservation metadata. A report of the situation in each national library partner was published in July 2000 (Borbinha and Cardoso 2000).

NEDLIB also provided small-scale development and testing of software tools used to build deposit systems including the following:

- NEDLIB Harvester. A freeware application for harvesting and archiving Web resources. Helsinki University Library and the Center for Scientific Computing jointly maintain the application. The harvester, its pilot use within NEDLIB, and its subsequent use by the national libraries of Iceland and Finland have been described by Juha Hakala (2001). The Nordic Web Archive is undertaking further collaborative development of access tools for Web archives.
- MMB System for Multimedia Access. MMB is an integrated client/server environment to support the workflow for electronic publications. Since October 1999, the MMB system has been used at Die Deutsche Bibliothek in Frankfurt, Leipzig, and Berlin.

Benefits

According to the project partners, NEDLIB provides a forum for the exchange of best practices in developing digital deposit systems. It helps build consensus and spread research costs. It serves at an intermediary level between global initiatives in digital preservation and local efforts from project participants. It directs those efforts toward converging solutions and thereby contributes to an emerging infrastructure for digital deposit libraries. For national libraries worldwide, NEDLIB delivers guidelines and a toolbox for local implementation of deposit systems.

4.3 Open Archival Information System Standard

In 1995, the International Standards Organization (ISO) asked Panel 2 of the Consultative Committee on Space Data Systems (CCSDS) to coordinate the development of standards to support the long-term preservation of digital information obtained from observations of the terrestrial and space environments. CCSDS began by developing a reference model to establish common terms and concepts for long-term digital preservation. Although this work was rooted in the space and earth observation communities, other communities, including NARA, became involved in the early development of this model. This involvement has grown as other initiatives have become aware of the draft standard and contributed to its development. In 2001, the draft reference model (CCSDS 2001) was submitted for

adoption as a formal ISO standard and will probably be formally adopted in 2002.

The reference model sets out to

- provide a framework for understanding and increasing awareness of archival concepts needed for long-term digital information preservation and access;
- provide the concepts nonarchival organizations need to be effective participants in the preservation process;
- provide a framework, including terminology and concepts, for describing and comparing architectures and operations of existing and future archives;
- provide a framework for describing and comparing different long-term preservation strategies and techniques;
- provide a basis for comparing the data models of digital information preserved by archives and for discussing how data models and the underlying information may change over time;
- provide a foundation that may be expanded by other efforts to cover long-term preservation of information that is not in digital form (for example, physical media and physical samples);
- reach a broader consensus on the elements and processes for long-term digital information preservation and access, and promote a larger market which vendors can support; and
- guide the identification and production of OAIS-related standards.

The model has been developed in a series of international workshops, augmented with e-mail exchanges and occasional teleconferences. National workshops in the United Kingdom, United States, and France have taken place between the international meetings. The national workshops have focused on developing national positions and input for the international efforts. The development of the reference model can be seen by surveying the reports and papers from past U.S., French, British, and international workshops.

Adoption and Implementation of the OAIS Reference Model

Development of the draft OAIS reference model has been an open process, with drafts available online. Although the process was protracted, this openness allowed the draft model to be reviewed, critiqued, and adapted by a wide range of organizations. It now has broad acceptance and influence. Sectors and initiatives that have adopted the model as a basis for their digital preservation efforts include the following:

- deposit libraries, such as the BL and the KB, which are specifying conformance with OAIS in their system development
- national archives, such as NARA
- scientific data centers, such as the U.S. National Space Science Data Center
- commercial organizations, such as the U.S. Aerospace Industries Association
- NEDLIB project

- CEDARS project
- Système d'Information, de Préservation et d'Accès aux Données (SIPAD) [System for Preservation and Access to Data and Information], the French space agency plasma physics archive
- OCLC/RLG Working Group on Preservation Metadata
- RLG/OCLC Working Group on Digital Archive Attributes

Future Developments

With the growing maturity and acceptance of the draft OAIS standard, attention has turned to identifying and starting additional archival standardization efforts. This is reflected in the Digital Archive Directions (DADs) workshop held in 1998 and the Archival Workshop on Ingest, Identification, and Certification Standards (AWIICS) held in October 1999.

The DADs workshop identified the three most urgent areas requiring additional work as being ingest, identification, and certification of archives. AWIICS explored these three areas in greater detail. Further work is now ongoing within CCSDS Panel 2 on ingest, under the leadership of CNES in France, and on archive certification, led by NARA in the United States.

There is also increasing interest among implementers of the standard in sharing experiences of implementation. In this context, it is interesting to note the RLG is implementing an OAIS resources Web site and mailing list as part of the RLG Long-term Retention Initiative.

Achievements and Constraints

Much intellectual effort has gone into developing the reference model over the past seven years. It has been an open process that has benefited from input from many sectors. It provides a common language and concepts for different professional groups involved in digital preservation and developing archiving systems. The outcome has been a reference model that has won widespread acceptance as a basis for digital preservation effort in all sectors that have reviewed it.

It is a good example of the advantages of a formal standards process in terms of intellectual rigor, consensus development, and use of a wide range of expertise and experience. It also illustrates the disadvantages of the process, in terms of time to reach widespread consensus and delays before a standard becomes official. The language of a formal standard can be off-putting for the uninitiated, and there can be a need for "vernacular" and accessible versions for a wider audience.

The reference model is a high-level model for describing digital archives. It does not mandate any implementation of the model. As such, the model has to be supplemented with additional standards and guidelines to achieve any implementation of the concepts. However, the OAIS reference model has already proved to be a critical foundation for digital preservation efforts internationally and seems likely to be the starting point for most, if not all, future initiatives in the field.

4.4 Preservation Technology for European Broadcast Archives

PRESTO is a 21-month, 4.8-million euro EU project to develop broadcast archive preservation technology. The BBC leads the project; two additional partners are the INA in France and Radiotelevisione Italiana (RAI) in Italy. Each partner leads with technology partners on a specific area of audiovisual material in the work packages: RAI for audio, INA for video, and the BBC for film.

Although not focused on digital preservation specifically (it is primarily concerned with the preservation of analog material), PRESTO addresses questions that are relevant to the issue. Audiovisual material is one of the few areas where digitization is considered to be the main option for preservation, because the originals are unstable or locked into obsolete technology. Resolving digital preservation issues has a major bearing on the long-term preservation of these materials.

Broadcasting technology was never meant to be a mechanism to create and hold permanent audiovisual history. The content of European public service broadcast archives is the social and cultural history of twentieth-century Europe, and a major part of this material is now at risk.

PRESTO consists of two major components: a survey of broadcast archives and efforts to develop new technology to reduce preservation project costs.

The Survey

A detailed survey (Wright 2001) was conducted of the archives of the three partners and other national broadcast archives in the user group. The purposes of the survey were to establish the scale of the problem, identify the solutions required, and help individual archives construct a business case for investment in preservation.

Key findings from this survey were as follows:

- Some 75 percent of the holdings surveyed are now at risk or inaccessible.
- Collections are growing at roughly four times the rate of current preservation work.
- An estimated 10 million hours of broadcast material of national and European significance are at risk.
- The cost of preserving broadcast material is about 100 euros per hour for audio and videotapes and 2,000 euros per hour for film.
- The total cost of preserving this material using current methods and technology is well over 1 billion euros.
- Unless new, more cost-effective preservation methods and technology can be found, the price of preservation may simply be too high, and we will lose significant portions of the audiovisual memory of the twentieth century.
- Digitization and mass storage is about 50 percent more expensive than copying to other formats, but is expected to double the usage of an asset.
- The aim of preservation is to retain for the future, as cost-effec-

tively as possible, that portion of existing broadcast archives that will contribute most to future usage.

- The conclusion from current archive usage figures is that the value of an item must be more than four times the cost of preservation to justify preservation on a commercial basis.
- For most broadcast archive material, this condition can easily be met, because one minute of sold or reused archive material will pay for preservation of one hour of archive material.
- For material that cannot pass the "commercial economics" criterion outlined above, there should be a safety net of assessment for cultural and historical value and a separate funding mechanism.

Preservation Technology

The final phases of the project consist of a program of technology development to assist mass digitization and preservation activities in the archives. This starts with surveying and documenting current methods of preservation work; documenting the factors of time, cost, and quality; and identifying key areas of high cost or time and areas of low quality. It also involves surveying the opportunities offered by new technology (for example, digital mass storage). The same factors of time, cost, and quality are to be specified, but new business opportunities and their potential costs and benefits are also being documented. On the basis of the preceding analysis, the project is identifying key technology gaps with regard to archive preservation and specifying in detail the requirements of the technology. The overall objective of the development phase is to produce new links in the preservation workflow that substantially reduce the cost of archive preservation.

Benefits

The survey has been completed and already has demonstrated its value in quantifying the scale of the challenges that broadcast archives face and in identifying cost elements of preservation and potential benefits of investment. Collecting the information was laborious, but the sharing of information on costs and potential savings is seen as immensely valuable.

The technology development is aimed at establishing "preservation factories" with throughput on a massive scale. Any bottlenecks are being identified and opportunities for automation and development of new tools are being explored. It is too early to say how successful this part of the program will be.

Audiovisual archives with very heterogeneous collections may have limited scope for mass preservation processes. Nonetheless, it is believed this approach will be essential for broadcast archives. It was also noted that cost models are a major and complex issue. Accounting practices may be critical to the process used. In organizations with few technical staff, it may be easier to fit preservation work into small-scale activity as part of existing programs and absorb the costs in ongoing staff budgets rather than to establish specific preservation programs. Where activity-costed accounting practices are applied, this will not be the case.

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Rothenberg, J., and T. Bikson. 1999. *Digital Preservation: Carrying Authentic, Understandable and Usable Digital Records Through Time. Report to the Dutch National Archives and Ministry of Interior by Rand-Europe*. The Hague.

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Wright, R. 2001. *Broadcast Archives: Preserving the Future.* Available at: http://presto.joanneum.ac.at/projects.asp#Pres.

5.2 Web Sites Consulted for the Study

Australia

National Archives of Australia
http://www.naa.gov.au

Council of Australian University Libraries
http://www.anu.edu.au/caul/

Digital Continuity Conference November 2001
http://www.swin.edu.au/lib/DigCon2001.htm

National Library of Australia (NLA)
http://www.nla.gov.au/

Our Digital Island (Tasmania State Library)
http://odi.statelibrary.tas.gov.au/

Preserving Access to Digital Information (PADI)
http://www.nla.gov.au/padi/

Preserving and Accessing Network Documentary Resources of Australia (PANDORA)
http://pandora.nla.gov.au/

ScreenSound Australia
http://www.screensound.gov.au/

France

Archives de France
http://www.archivesdefrance.culture.gouv.fr/

Bibliothèque nationale de France (BnF)
http://www.bnf.fr

Consortium Universitaire des Périodiques Numériques (COUPERIN)
http://buweb.univ-angers.fr/COUPERIN.html

Institut National de l'Audiovisuel (INA)
http://www./ina.fr

Pérennisation des Informations Numériques (PIN)
http://sads.cnes.fr:8010/pin/welcome.html

The Netherlands

Academic Research in the Netherlands Online (ARNO)
http://www.uba.uva.nl/en/projects/arno/

Digitale Duurzaamheid
http://www.digitaleduurzaamheid.nl

Koninklijke Bibliotheek (KB)
http://www.kb.nl
http://www.kb.nl/kb/resources/frameset_kenniscentrum.html

Netherlands Institute for Scientific Information Services (NIWI)
http://www.niwi.knaw.nl

Rijksarchiefdienst
http://www.archief.nl

Roquade
http://www.roquade.nl

Testbed Digitale Bewaring
http://www.digitaleduurzaamheid.nl/index.cfm?paginakeuze=181&categorie=2

United Kingdom

Arts and Humanities Data Service (AHDS)
http://ahds.ac.uk/

British Library (BL)
http://www.bl.uk

CAMiLEON Project
http://www.si.umich.edu/CAMILEON

CEDARS Project
http://www.leeds.ac.uk/cedars/

Digital Preservation Coalition (DPC)
http://www.dpconline.org

Joint Information Systems Committee of the Higher and Further Education Councils (JISC) Digital Preservation Focus
http://www.jisc.ac.uk/index.cfm?name=pres_home

National Preservation Office (NPO)
http://www.bl.uk/services/preservation/national.html

Public Records Office (PRO)
http://www.pro.gov.uk

U.K. Research Councils (e-science program)
http://www.research-councils.ac.uk/escience/membership.shtml

Multinational Initiatives

Electronic Resource Preservation and Access Network (ERPANET)
http://www.erpanet.org/

Networked European Deposit Library (NEDLIB)
http://www.kb.nl/coop/nedlib/homeflash.html

Nordic Web Archive
http://nwa.nb.no/

Open Archival Information System (OAIS)
Consultative Committee for Space Data Systems
http://www.ccsds.org/

Digital Curation (digital archives, libraries, and e-science)
http://www.dpconline.org/graphics/events/index.html#curation

International Standards Organization (ISO) Archiving Standards Overview
http://ssdoo.gsfc.nasa.gov/nost/isoas/

Preservation Technology for European Archives (PRESTO)
http://presto.joanneum.ac.at/index.asp

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